Effects of Habitat Disturbance on Diversity and Abundance of Ants in the Southeastern Fall-Line Sandhills

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Ecological Indicator Systems (EISs)

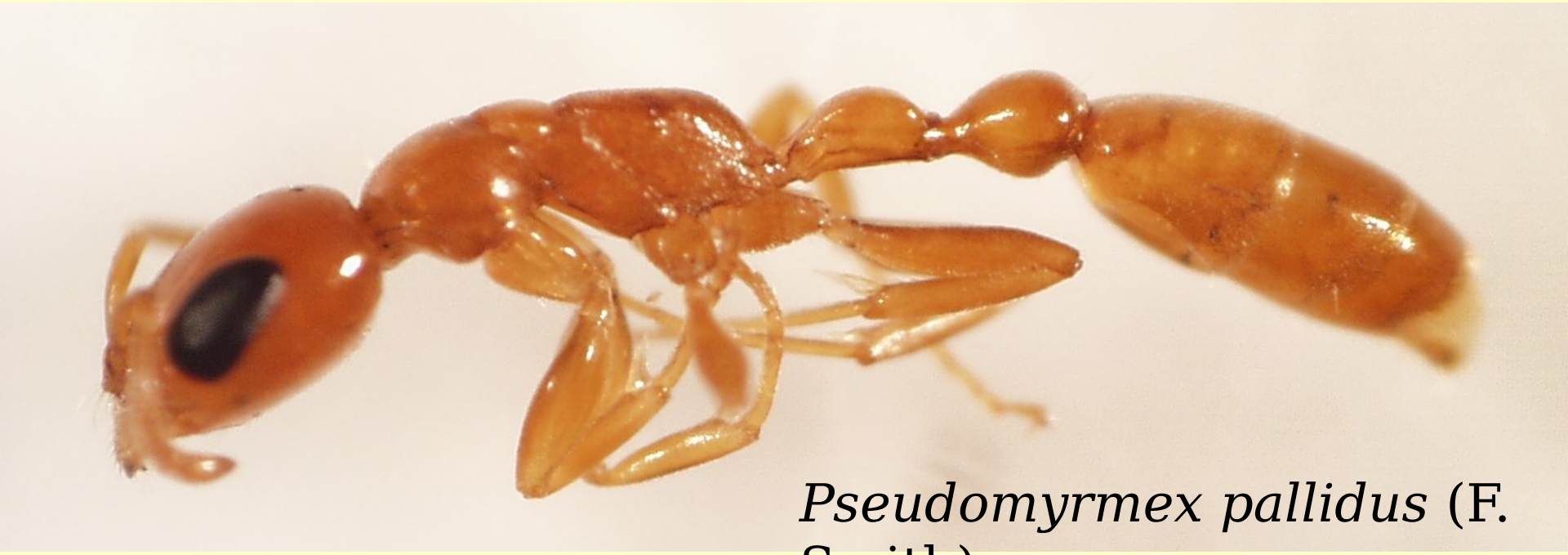
- habitat characteristics
- ground cover community
- microbial community
- soil chemistry
- nutrient leakage
- invertebrate community
- developmental instability
- plant physiology
- woody ground cover spatial dynamics

Ecological Indicator Systems (EISs)

Our goal is to evaluate these nine systems individually, and in combination, to develop classes of metrics termed **Indicator Guilds**

Indicator Guild is a class of variables that respond in a similar fashion and define a disturbance gradient

Ants (Formicidae)



Pseudomyrmex pallidus (F. Smith)

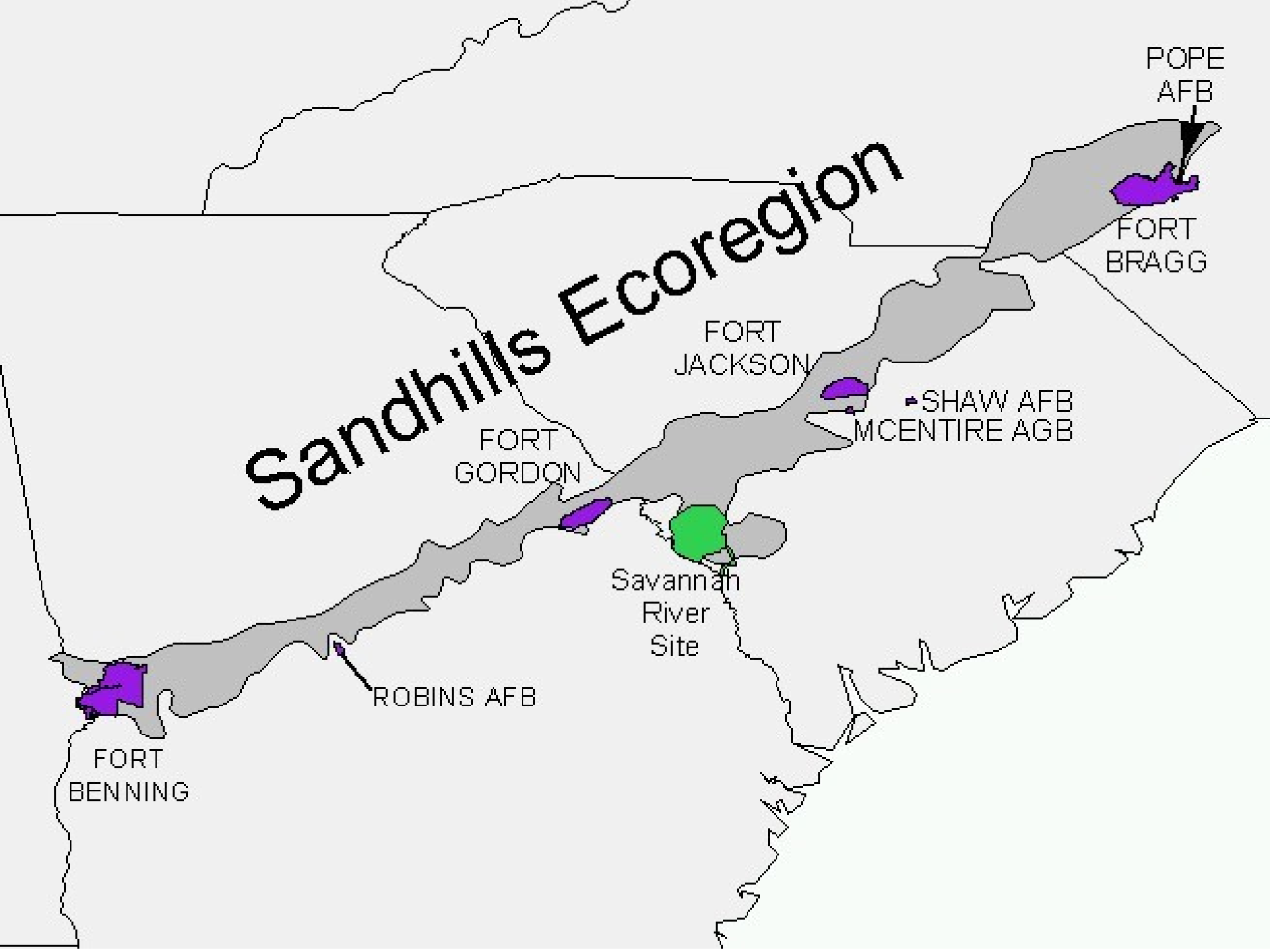
Ants as Indicators of Disturbance

- occur throughout the world
- easily collected
- taxonomically well known
- constitute an important fraction of the animal biomass in terrestrial ecosystems

Ants Perform Major Ecological Functions

- dominant predators in their size range
- usually the dominant scavengers
- soil mixing, nutrient transport, and soil aeration
- major granivores in arid regions
- important for pollination, dispersal, and protection of numerous plants

Courtesy of Michelle Brown


POPE
AFB
FORT
BRAGG
Sandhills Ecoregion
FORT
JACKSON
SHAW AFB
MCENTIRE AGB
FORT
GORDON
Savannah
River
Site
ROBINS AFB
FORT
BENNING

Fall-Line Sandhills

- Soil
  - Loamy sands
- Forest
  - Longleaf Pine
  - Loblolly Pine
  - Shortleaf Pine
  - Oaks and Hickories

Three Disturbance Regimes

- Low: L1, L2, L3
- Medium: M1, M2, M3
- High: H1, H2, H3

Low Disturbance

No military training Minimal foot traffic

Medium Disturbance

Past training activities
Current foot traffic

High Disturbance

Current mechanized-infantry training

Abrams Battle Tank

Bradley Fighting Vehicle

HMMWV
(*Humvee*)

Highly disturbed sites had

- Fewer trees
- Diminished ground cover
- More compacted soils with a shallower A-horizon

Ant Sampling

Pitfall Trap

Sweep-net

Searchi
ng of
tree
trunks

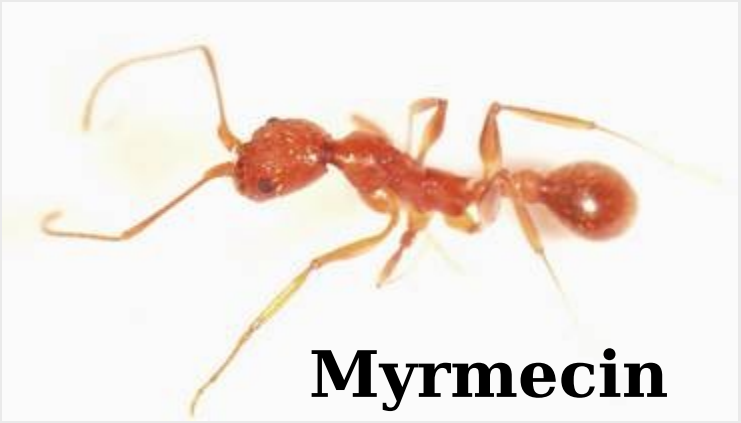
Ants Sampled (2000-2002)

- 105,638 ants in pitfall traps
- 1,228 ants in sweep nets
- 2,824 ants from the lower trunks of pines and oaks

Subfamilies of Formicidae

Ponerinae

Pseudomyrmecinae



Myrmecinae

Dolichoderinae

Formicinae

45 Species

- Ponerinae – 2 spp
- Myrmecinae – 25 spp
- Pseudomyrmecinae – 1 sp
- Dolichoderinae – 4 spp
- Formicinae – 13 spp

Physical Environment

- A-Horizon Soil Depth (mm)
- Soil Compaction (Lang Units)
- Soil Shear Strength (kg/cm^2)
- Bare Soil (%)

Vegetation

- Forbs (%)
- Grass (%)
- Woody Plants (%)
- Diameter Breast Height (cm)
- Number of Trees per 3600 m^2
- Canopy Cover (%)
- Basal Area (ft^2/acre)
- Sapling Density (number/3600 m^2)
- Small Tree Density (number/3600 m^2)
- Medium Tree Density (number/3600 m^2)
- Large Tree Density (number/3600 m^2)

Courtesy of Jones
Environmental Center

Wildfires and prescribed burns in our study sites (1980-2002)

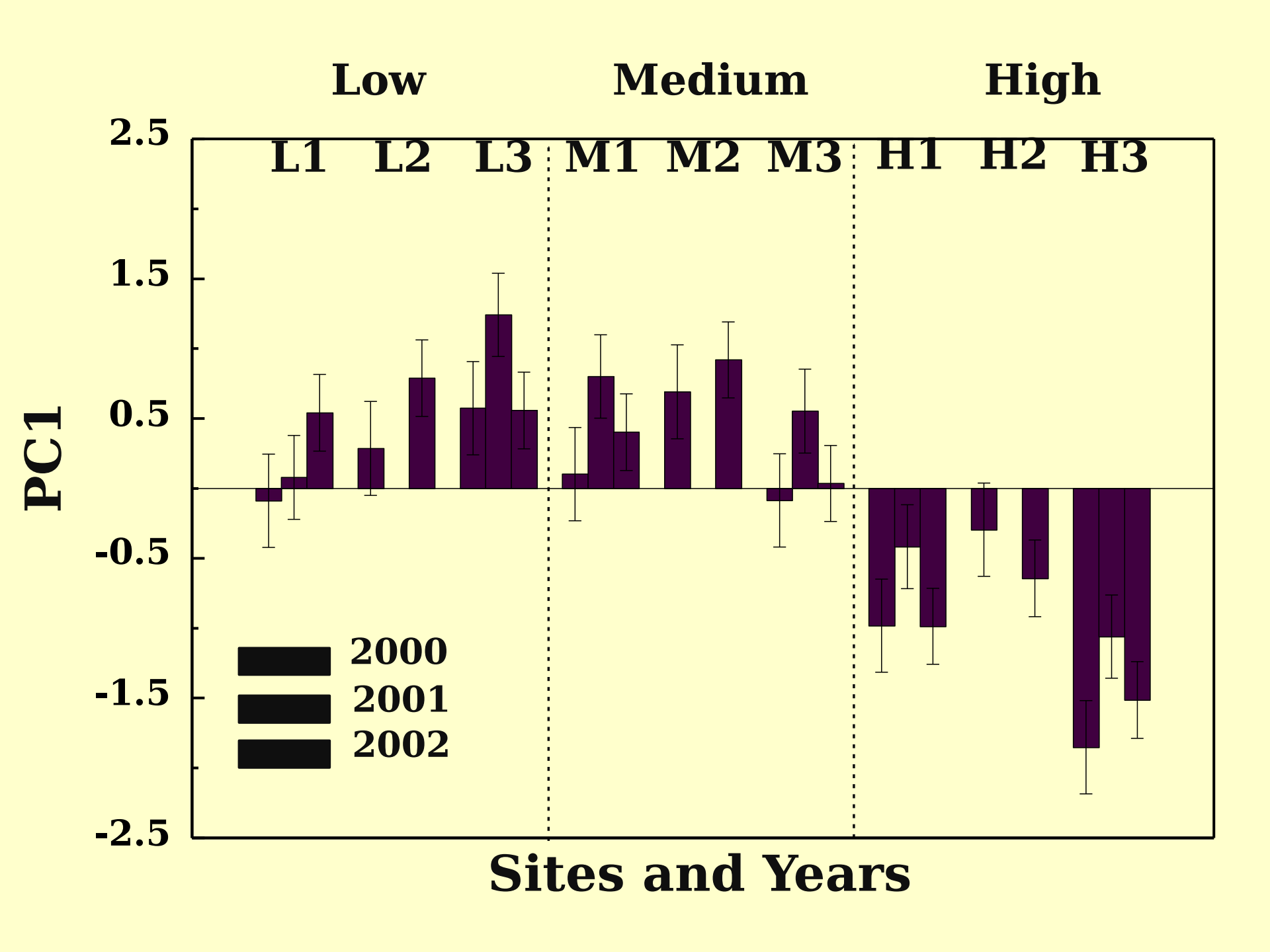
Site	**Wildfires**	**Prescribed Burns**
L1	1	8
L2	3	11
L3	1	9
M1	1	7
M2	2	4
M3	1	4
H1	3	8
H2	1	7
H3	0	3

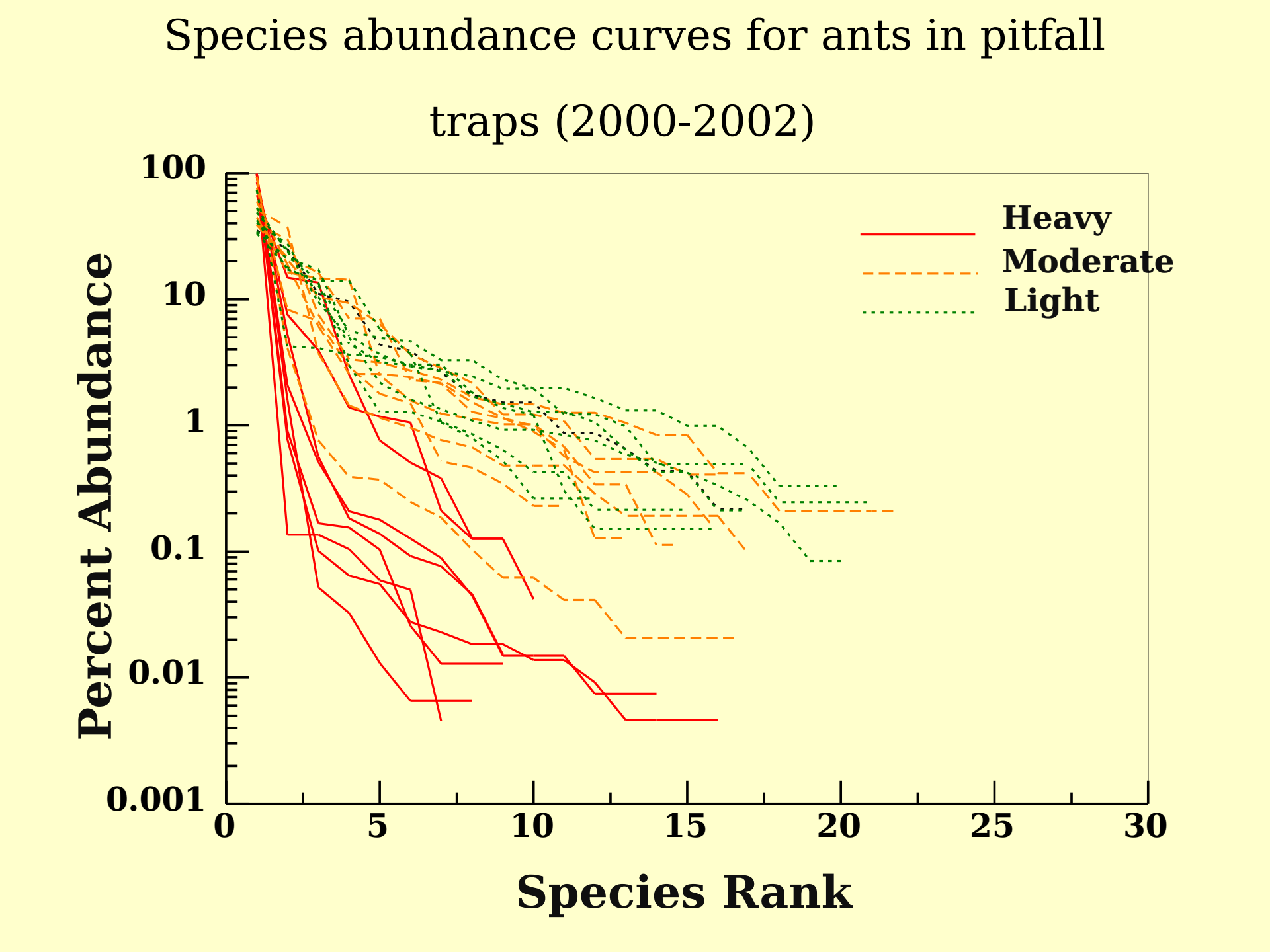
Prescribed Burns (1999-2002)

Site	1999	2000	2001	2002
L1	1	0	1	1
L2	1	0	1	0
L3	1	0	0	1
M1	1	0	0	1
M2	0	1	0	0
M3	0	0	0	0
H1	0	0	0	0
H2	1	0	0	1
H3	0	0	0	0

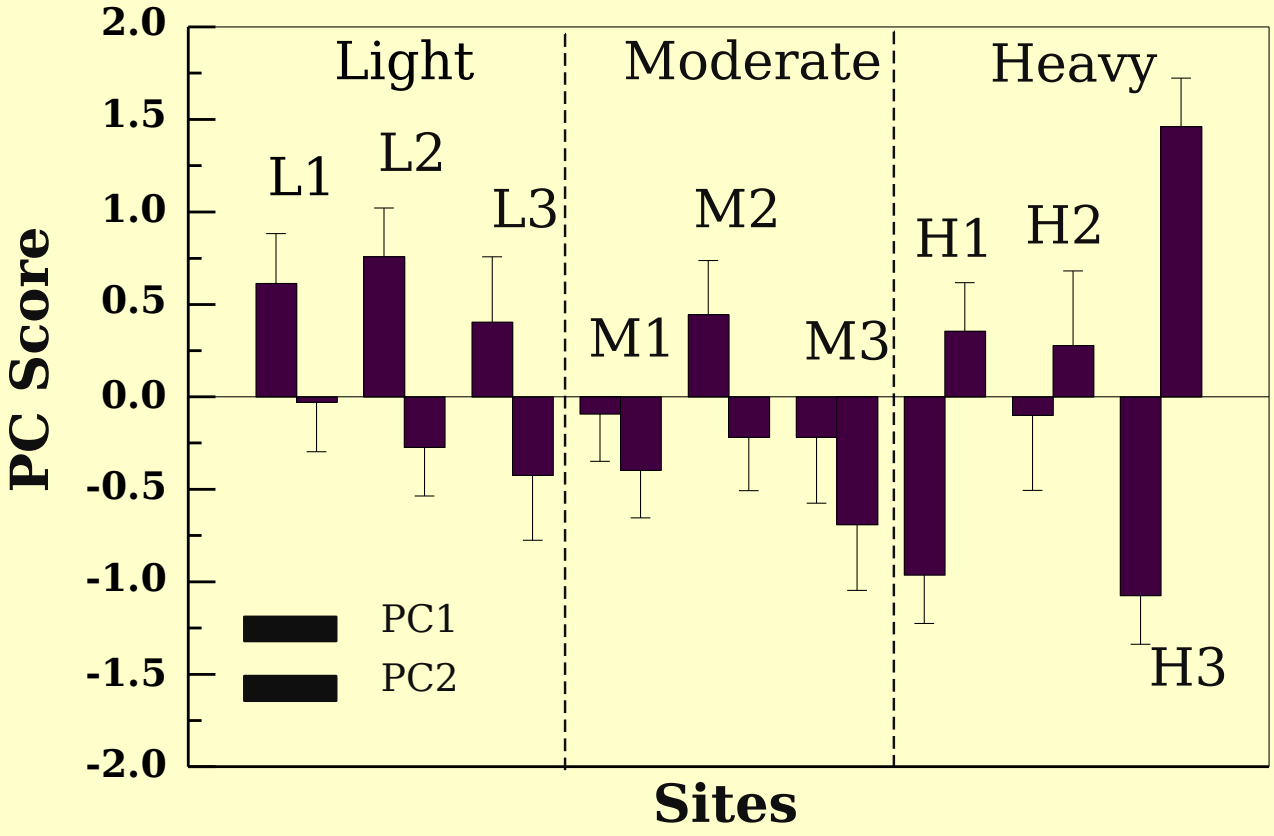
Principal Component Loadings for Pitfall Trap Samples (2000-2002)

Variable	PC1	PC2
Number of Species	**0.793**	**0.521**
Number of Individuals	**-0.669**	**0.653**
Simpson Index	**-0.930**	0.163
Shannon Index	**0.962**	-0.063
Species Richness	**0.938**	0.251
Percent of Variance	74.931	15.825

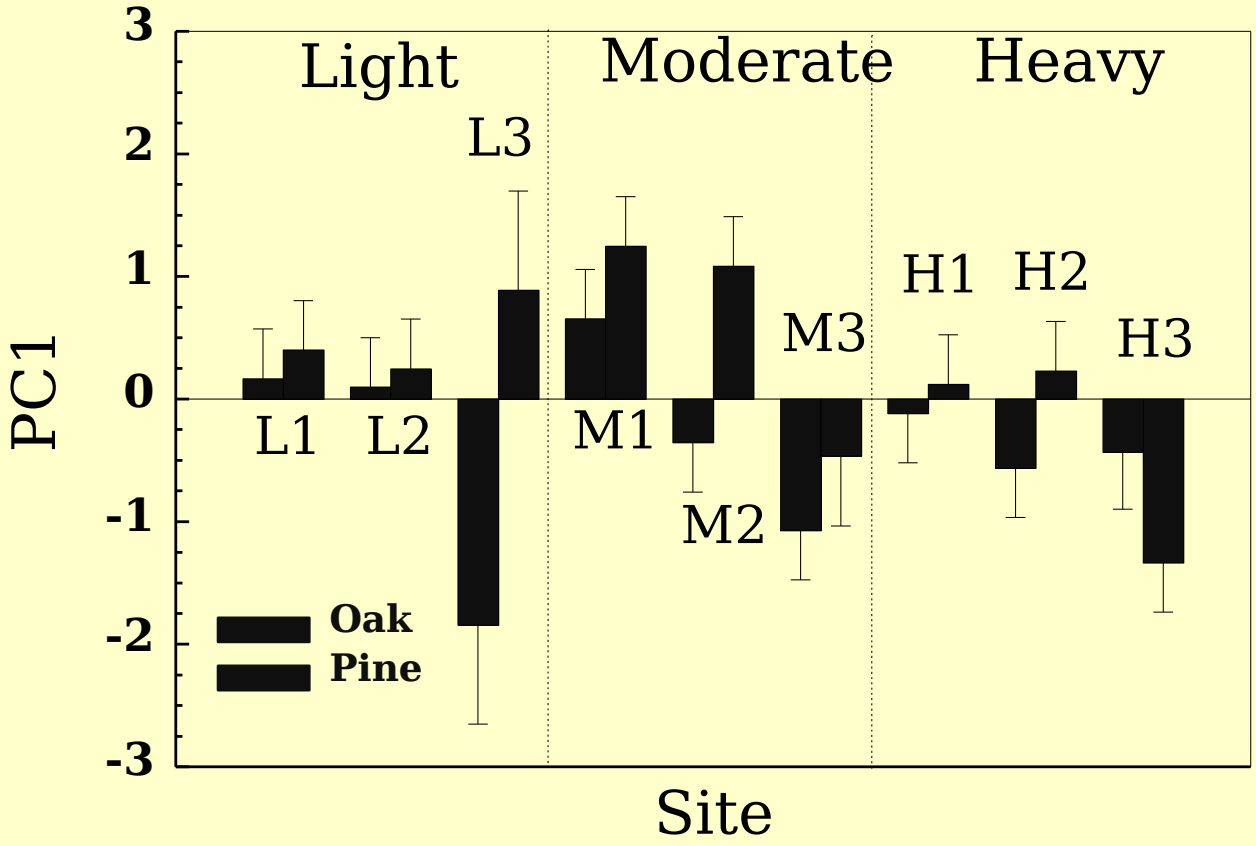

Low
Medium
High
L1
L2
L3
M1
M2
M3
H1
H2
H3
2.5
1.5
0.5
-0.5
-1.5
-2.5
PC1
2000
2001
2002
Sites and Years


Species abundance curves for ants in pitfall traps (2000-2002)
Percent Abundance
100
10
1
0.1
0.01
0.001
0
5
10
15
20
25
30
Species Rank
Heavy
Moderate
Light

Diversity and abundance of ants in sweep-net samples, by site (mean plus standard error)

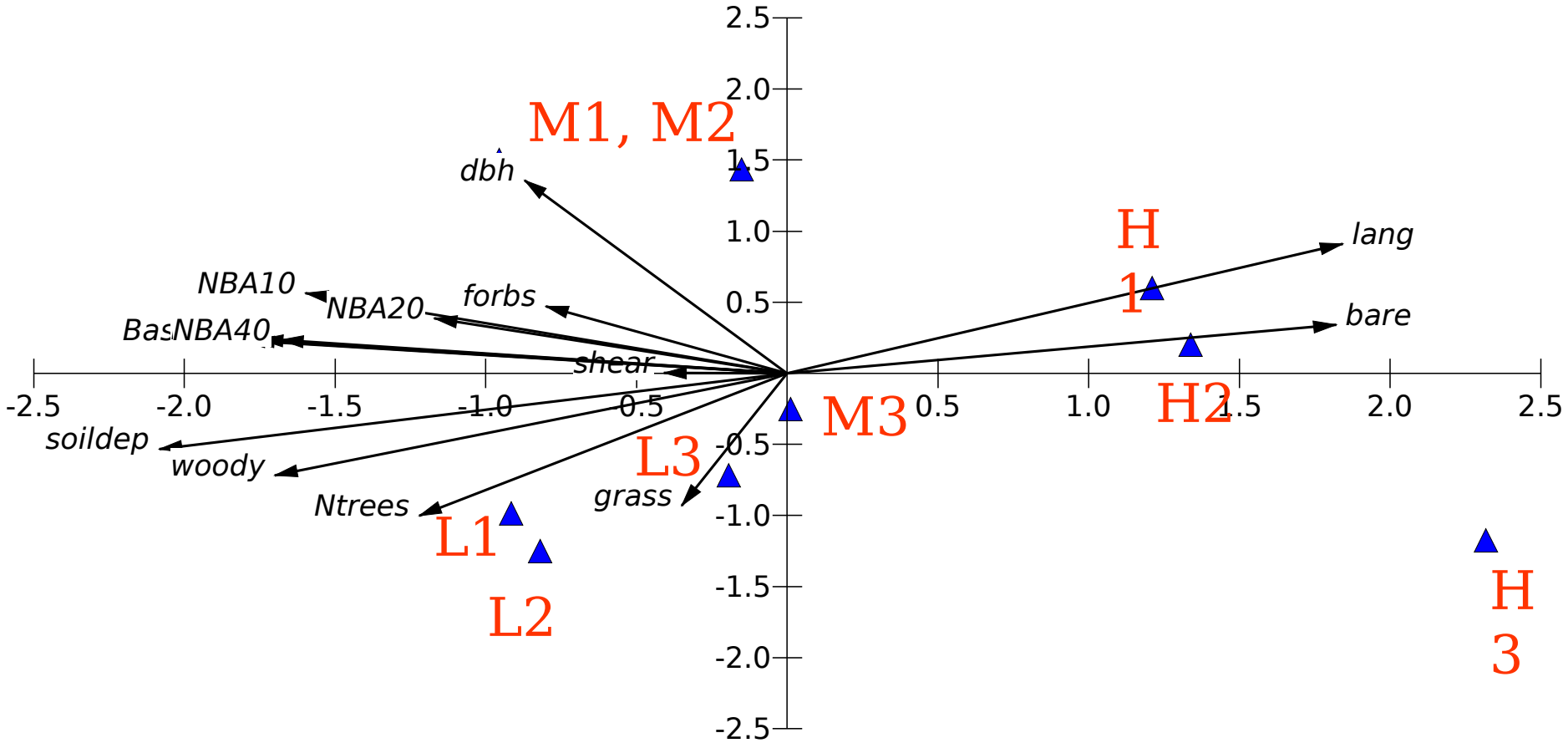


Diversity of Ants on Oak and Pine (2002)

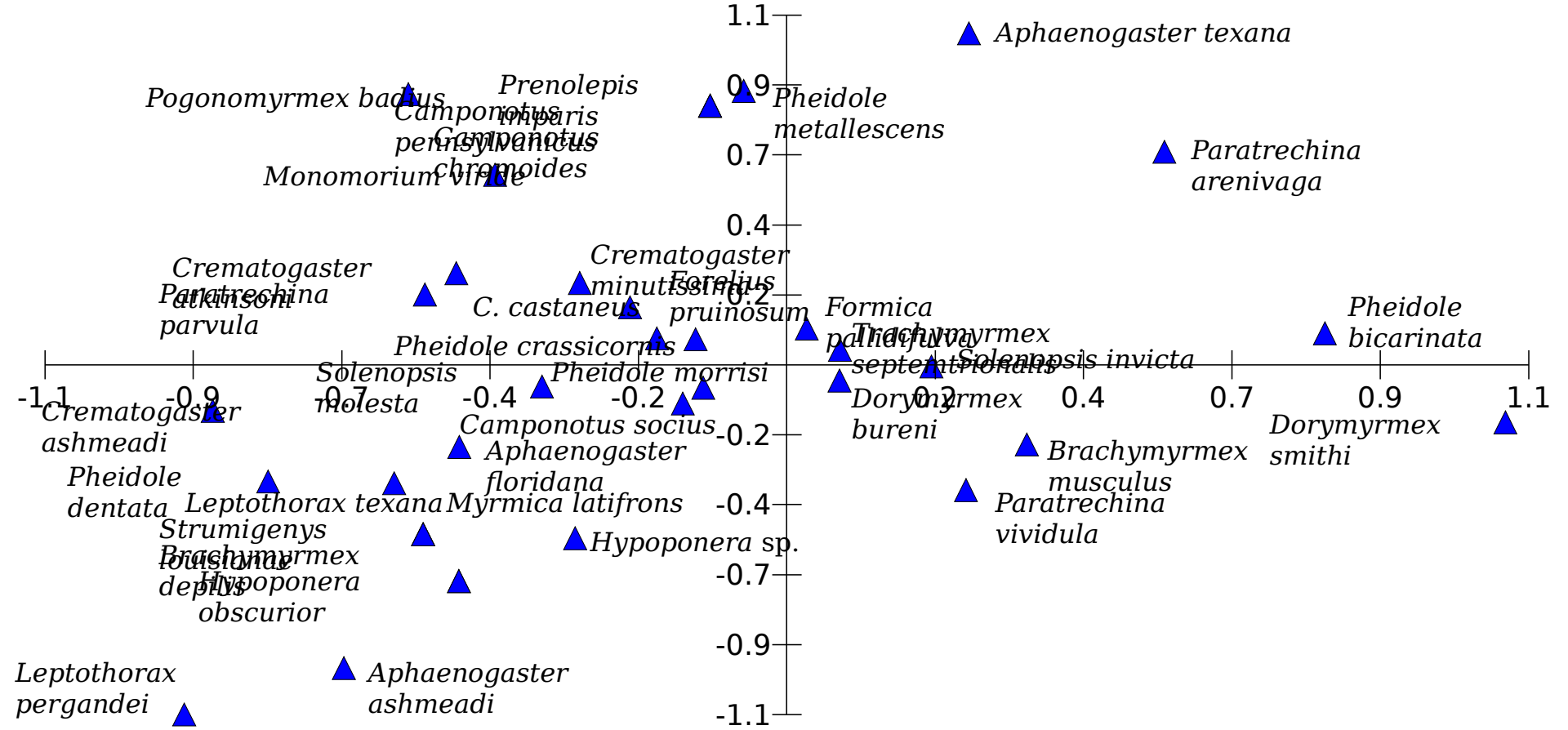


Canonical correspondence analysis of pitfall samples in 2002

Site Scores



Canonical correspondence analysis of pitfall samples in 2002
Species Scores



Dorymyrmex bureni

Dorymyrmex

Crematogaster ashmeadi is an Important Food of the Red-Cockaded Woodpecker

Solenopsis invicta

Conclusions

- Highly disturbed sites had fewer trees, diminished ground cover, and more compacted soils with a shallower A-horizon
- Highly disturbed areas had fewer species, and greater numbers, of ants than did moderately or lightly disturbed areas

Conclusions (Continued)

- The ant communities in disturbed areas were also less equitable, and were dominated by active Dolichoderinae, especially *Dorymyrmex smithi*
- Prescribed burning at several of our sites had no detectable influence on either the species diversity or abundance of ants

Acknowledgements

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Courtesy of Michelle Brown